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HIGH-GAIN, LONG-PERIOD SEISMOGRAPH STATION

INSTALLATION REPORT

Fairbanks, Alaska

by

Andrew J. Murphy

Lamont-Doherty Geological Observatory

of

Columbia University

31 March 1971

**Details of illustrations in
this document may be better
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13. ABSTRACT This report describes the installation of a high-gain, long-period seismograph system at Fairbanks, Alaska. The station is located at 64°53'58" north latitude, 143°00'20" west longitude at an elevation of 330 m above sea level in a tunnel approximately 15 km from the World-Wide Standardized Seismic Network (WSSN) station COL instrument vault. The system consists of three Geotech seismometers with natural periods of 30 sec (one vertical and two horizontal) each with two velocity transducers and one displacement transducer. One velocity transducer is coupled to a Kinometrics galvanometer with a natural period of 100 sec from which the signal is amplified by a phototube amplifier (P. T. A.) and recorded photographically and digitally (designated high-gain component). The signal from the second velocity transducer is coupled directly to a recording galvanometer and recorded photographically (designated standard component). The displacement transducer signal is recorded digitally. The system can operate with gains up to 500,000 at periods of 35 to 45 sec. This high sensitivity has been achieved by isolating the seismometer from barometric changes, by electronically filtering out the 6 second microseisms and by shaping the instrument response to correlate with a natural low in the earth-noise spectrum. The seismometers and phototube amplifiers are housed in a chamber sealed from the environment by three ship-type bulkhead doors. The photographic drum recorders, recording galvanometers, control console and digital data acquisition system are located in an adjacent room 15m from the seismometers.			

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LAMONT-DOHERTY GEOLOGICAL OBSERVATORY
OF COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

HIGH-GAIN, LONG-PERIOD SEISMOGRAPH STATION

STATION: OLD CLIPPER MINE
Fairbanks, Alaska

STATION MANAGER: Lloyd Lounsbury
220 Charles Street
Fairbanks, Alaska

STATION ATTENDANTS: Herbert Mann
George Lounsbury
220 Charles Street
Fairbanks, Alaska

STATION INSTALLATION: Dates - 17 August 1977 to 26 September
1977
Personnel - Merrill Conner
(L. -D. G. O.)
Shannon Cory (L. -D. G. O.)
Tracy Johnson (L. -D. G. O.)
Andrew J. Murphy (L. -D. G. O.)

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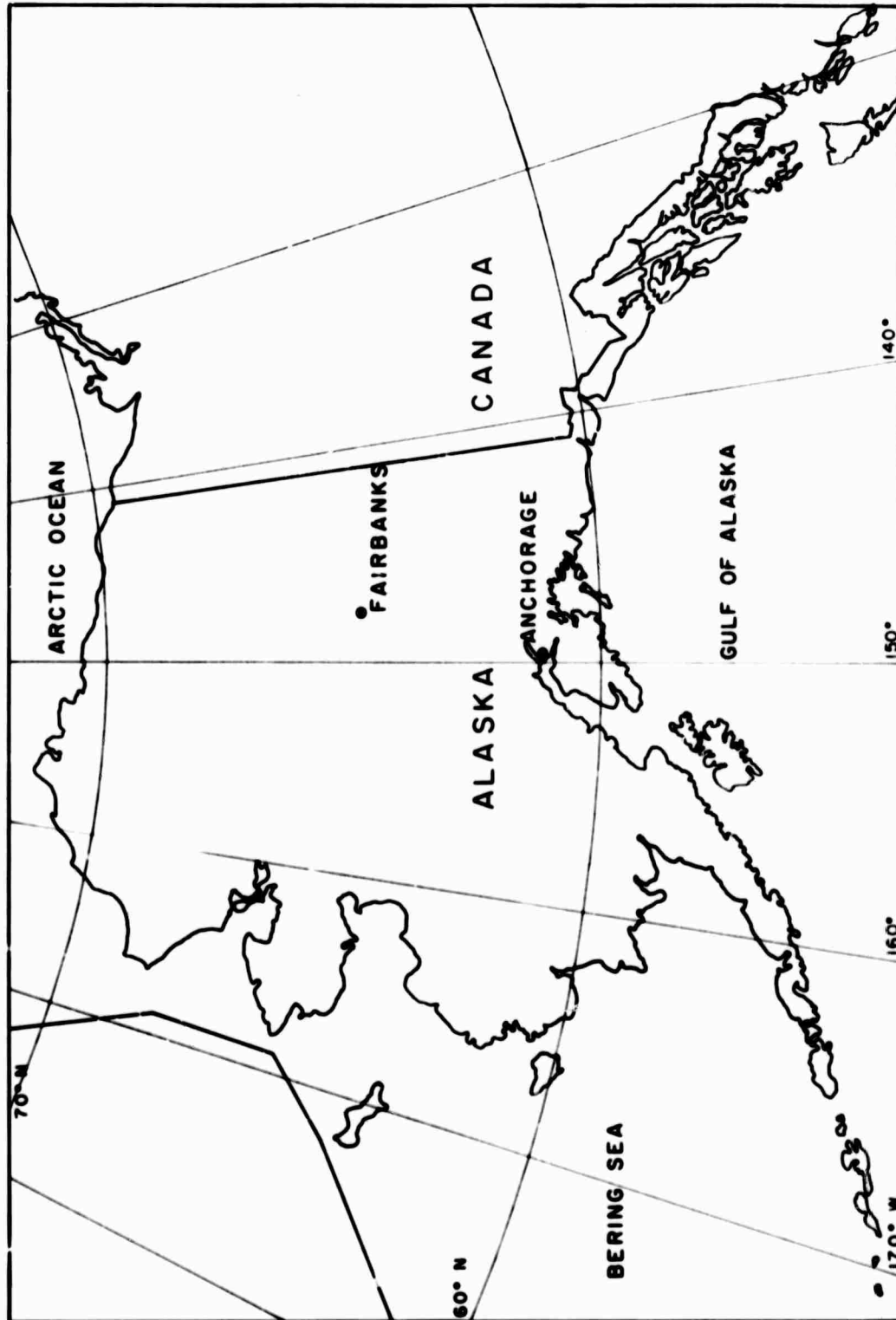


Figure I-1: Map of Alaska showing location of Fairbanks.

Coordinates: **Latitude** 64°53'58" N
 Longitude 148°00'20" W
Elevation above sea level: 330 meters

LOCAL PHYSIOGRAPHY

The gold mine in which the station is located is at the head

NOT REPRODUCIBLE

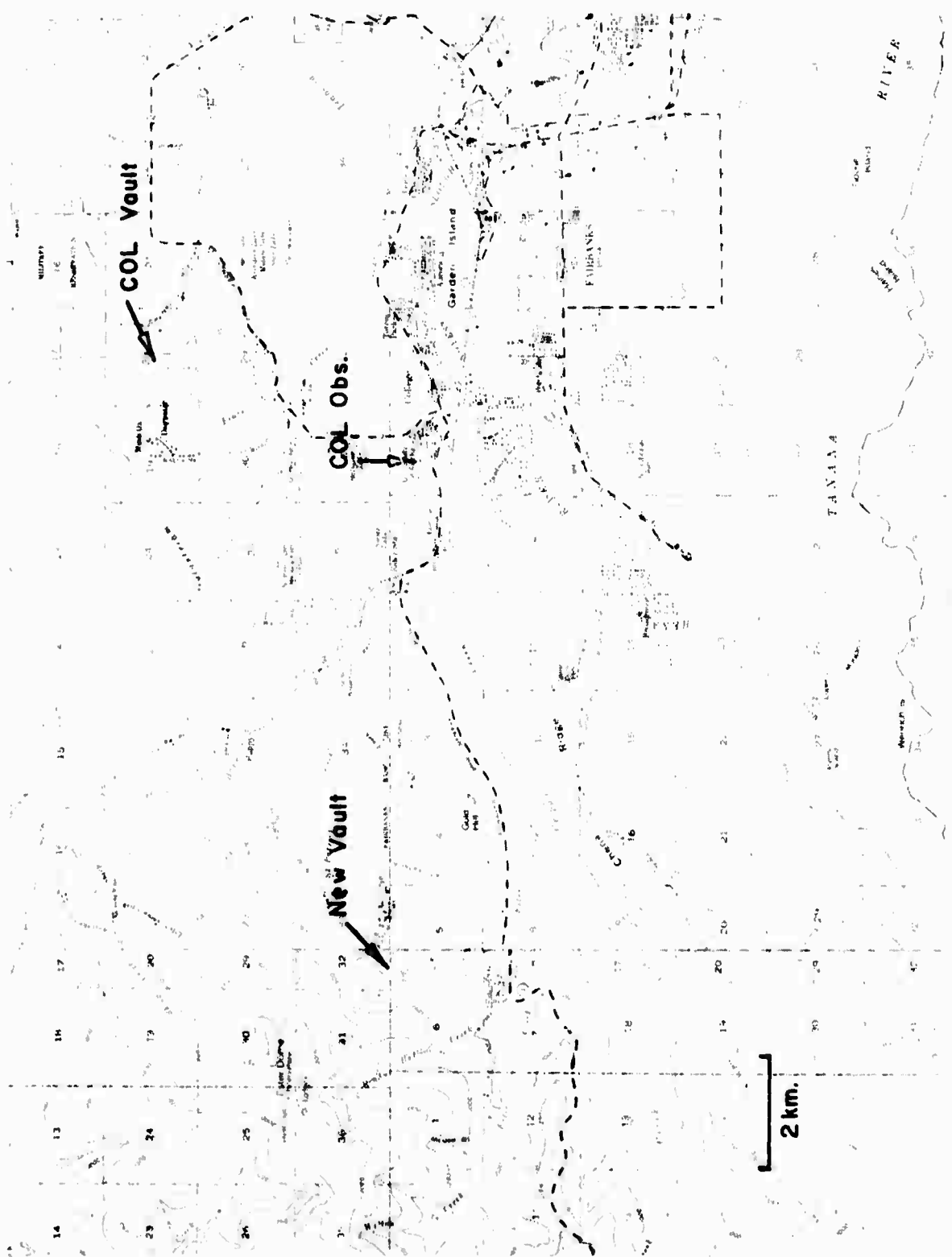


Figure I-2: Topographic map of Fairbanks - College district. Seismograph station is indicated by arrow; the WSSN instrument vault for COL and the College Observatory are also indicated.

of a valley approximately 14 km from Fairbanks at an elevation of 330 meters. The area is drained by the Tanana River, a tributary of the Yukon River, which drains much of Alaska. The closest approach of the Tanana to the station is 8 km. The mountain, on which the mine is located, is called Ester Dome. It is covered with a variety of trees from 6.5 to 13 meters tall (20 to 40 feet).

Much of the Tanana Valley is subject to permafrost, but the mine site is approximately 2 km from any area that is subject to this phenomena.

CLIMATE

The climate of the Fairbanks area is semi-arid with about 30 cm (12 in.) of precipitation annually. Snowfall occurs usually from October to April and totals from 60 to 130 inches. Low temperatures reach below -51°C (-60°F) and high temperatures may go above $+35^{\circ}\text{C}$ ($+95^{\circ}\text{F}$) in any given year. Figure I-3 shows a graph of temperature variation averaged for the period of 1931 to 1960.

LOCAL GEOLOGY

Until recently the Fairbanks District of the Yukon-Tanana lowlands has been one of the major gold-mining camps on the North American continent. The area contains valuable deposits of gold, antimony, and tungsten. For economic reasons, numerous

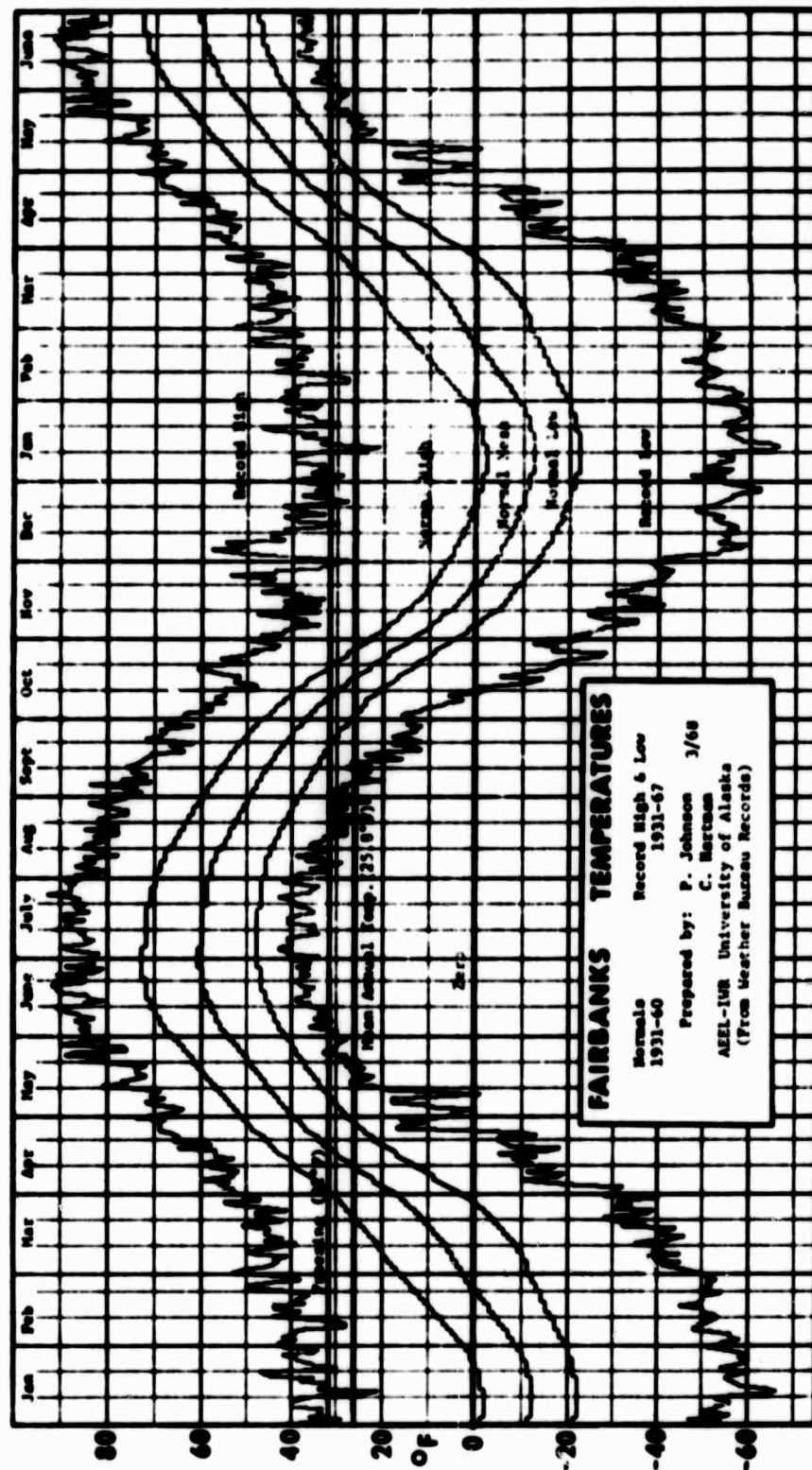


Figure I-3: Graph of the variation in temperature at Fairbanks averaged over the period 1931-60.

reports have been written on the area including a comprehensive paper by Mertie (1936).

Within the 20 kilometers of Fairbanks, only two significant formations are exposed; Quaternary sedimentary deposits and the Birch Creek schist (Figure I-4). The Quaternary deposits, which vary in thickness from a few inches to several hundred feet, consist of the Fairbanks loess, frozen silts, reworked creek gravels, and flood plain alluvium. These deposits rest uncomfortably on the Birch Creek schist, which has been dated as early Precambrian.

"The most complete published description of the Birch Creek schist is that by Mertie, who described it as consisting of quartzite, quartzite schist, quartzmica schist, mica schist, feldspathic and chloritic schists, and a minor proportion of carbonaceous and calcareous schist and crystalline limestone, with quartzite schist and quartz-mica schist the commonest type. Most of these rocks are completely recrystallized, though in some evidences of their sedimentary origin can still be recognized. In general, they are highly foliated and in many places show evidences of later schistose structures superposed on earlier ones.

"The structure of the Birch Creek schist is so complex that its history is almost indecipherable. In most places the bedding planes have been completely destroyed, and the only observable

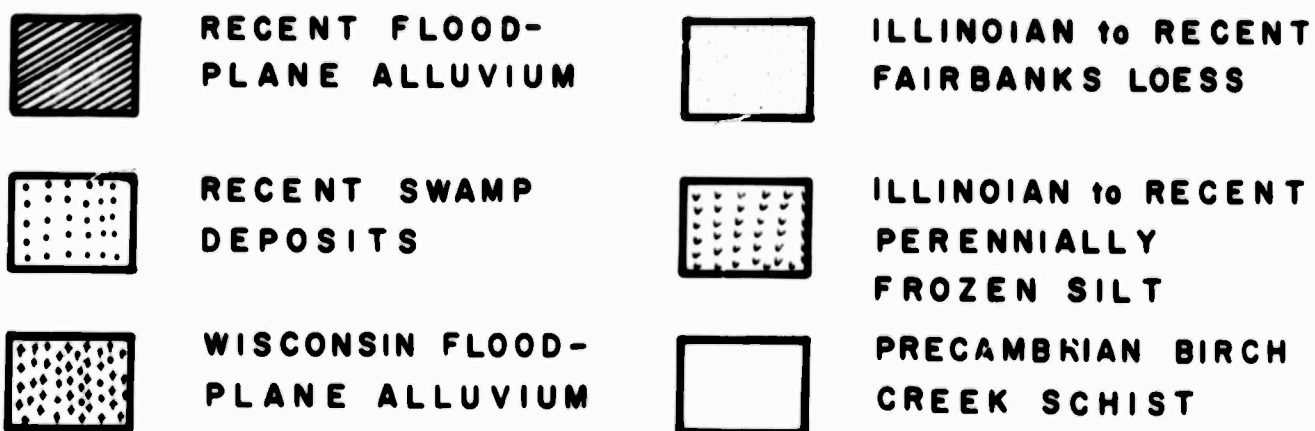


Figure I-4: Geologic map of the Fairbanks-College district. Seismograph station is indicated by arrow. The area is approximately 73 km x 36 km.

structural features are the planes of schistosity. This cleavage has a general strike of N60°E, though many divergences from that trend may be noted. Mertie states that the distribution of the more quartzite phases of the schist, which he believes to represent the lower portion of the formation, indicates that the general structure is anticlinal with a plunge to the southwest" (Capps, 1940).

STATION'S RELATION TO MAN-MADE STRUCTURES

There are no large structures in the immediate vicinity of the tunnel (Figure I-5). Including the owner's cabin at the entrance to the tunnel, there are only a few houses and abandoned mine works within five km of the tunnel.

The main highway (Fairbanks-Nenana Rd.) and the Alaskan Railroad (Figure I-2) are approximately 2 km and 4.4 km respectively from the station at their closest point. Henderson Road, the access road to the mine, is a gravel road with light traffic during the summer months and little traffic during the winter. The city of Fairbanks, with a population of 40,000, is the primary transportation and commercial center for central Alaska with only light support industry. The closest river, the Chena, is 7 km southeast of the station; it joins the larger Tanana 9.2 km south of the station.

There are no apparent local sources for long period noise.

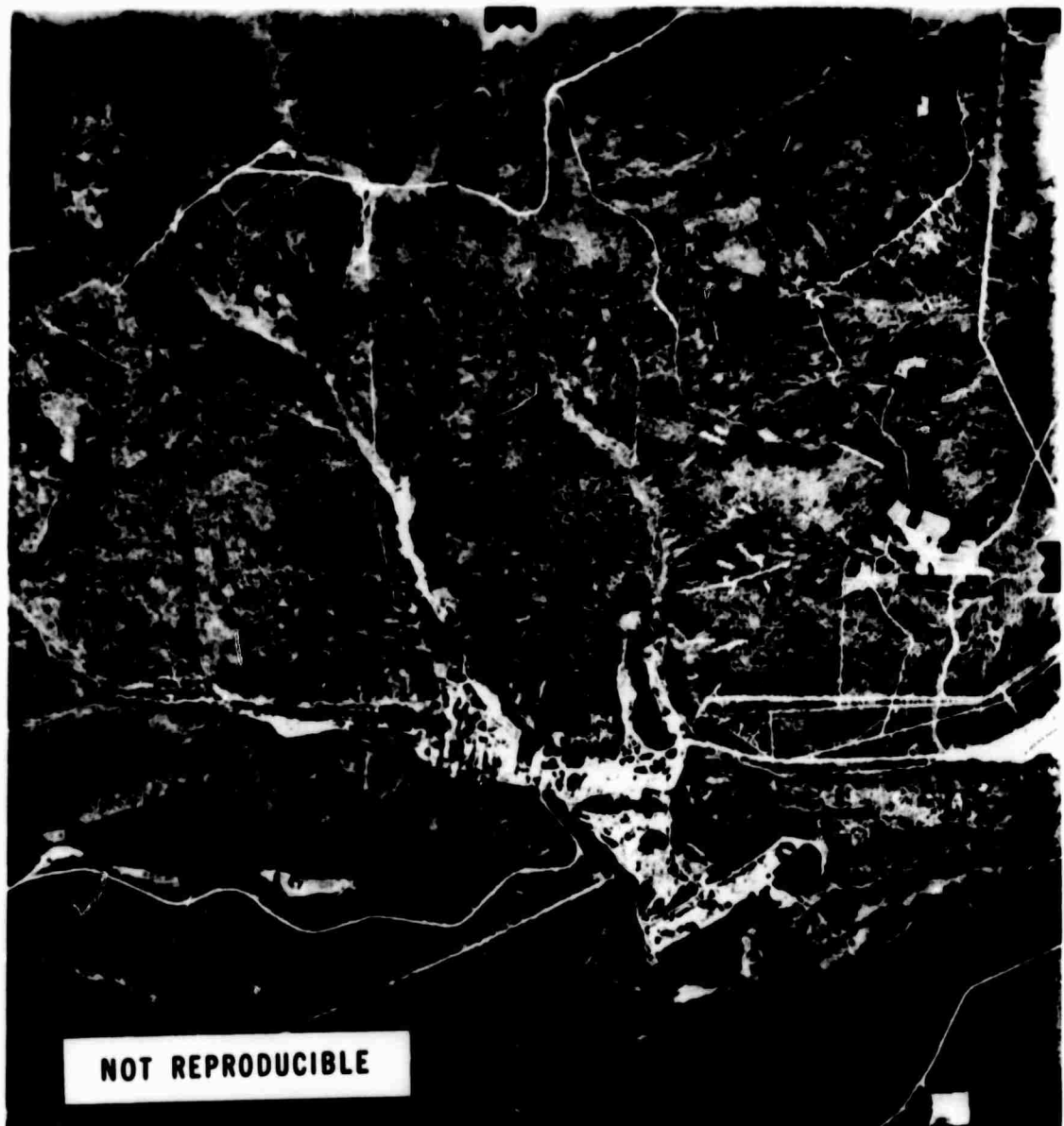


Figure I-5: Aerial photograph of the eastern and central portions of Ester Dome. The location of the seismograph station is indicated by an arrow. The area is approximately 7.5 km x 7.5 km.

II: STATION CONSTRUCTION AND INSTALLATION

The station is situated in a former gold mine approximately 130 m from the entrance and beneath 20 m of overburden (Fig. II-1). The side tunnel, in which the equipment is located, is partitioned into four rooms: (Figure II-2) seismometer chamber, phototube amplifier (P. T. A.) room, photographic recording room, and console room. In order to provide sufficient space for all the equipment, it was necessary to enlarge the side tunnel from the dimensions in Figure II-1 to those shown in Figure II-2.

SEISMOMETER AND P. T. A. ROOMS

The original plans for the Alaskan station called for the installation of two ship-type bulkhead doors in poured concrete walls. The purpose of these walls is to isolate the long-period seismometers as much as possible from external variations in temperatures and barometric pressure. Because the rock between the console room and the seismometer chamber is badly fractured, a decision was made to increase the surface area of contact between the concrete walls and the rock face of the tunnel. To obtain this increased surface area, a single, hollow concrete plug was poured instead of the two concrete walls. The hollow portion of the plug serves as the P. T. A. room (Figure II-1). To further

PORTAL

THE TUNNELS CONTINUE ABOUT 200 FT.
BEYOND POINTS A & B

AREA TO BE ENLARGED FOR
SEISMOGRAPH STATION

OLD CLIPPER GOLD MINE

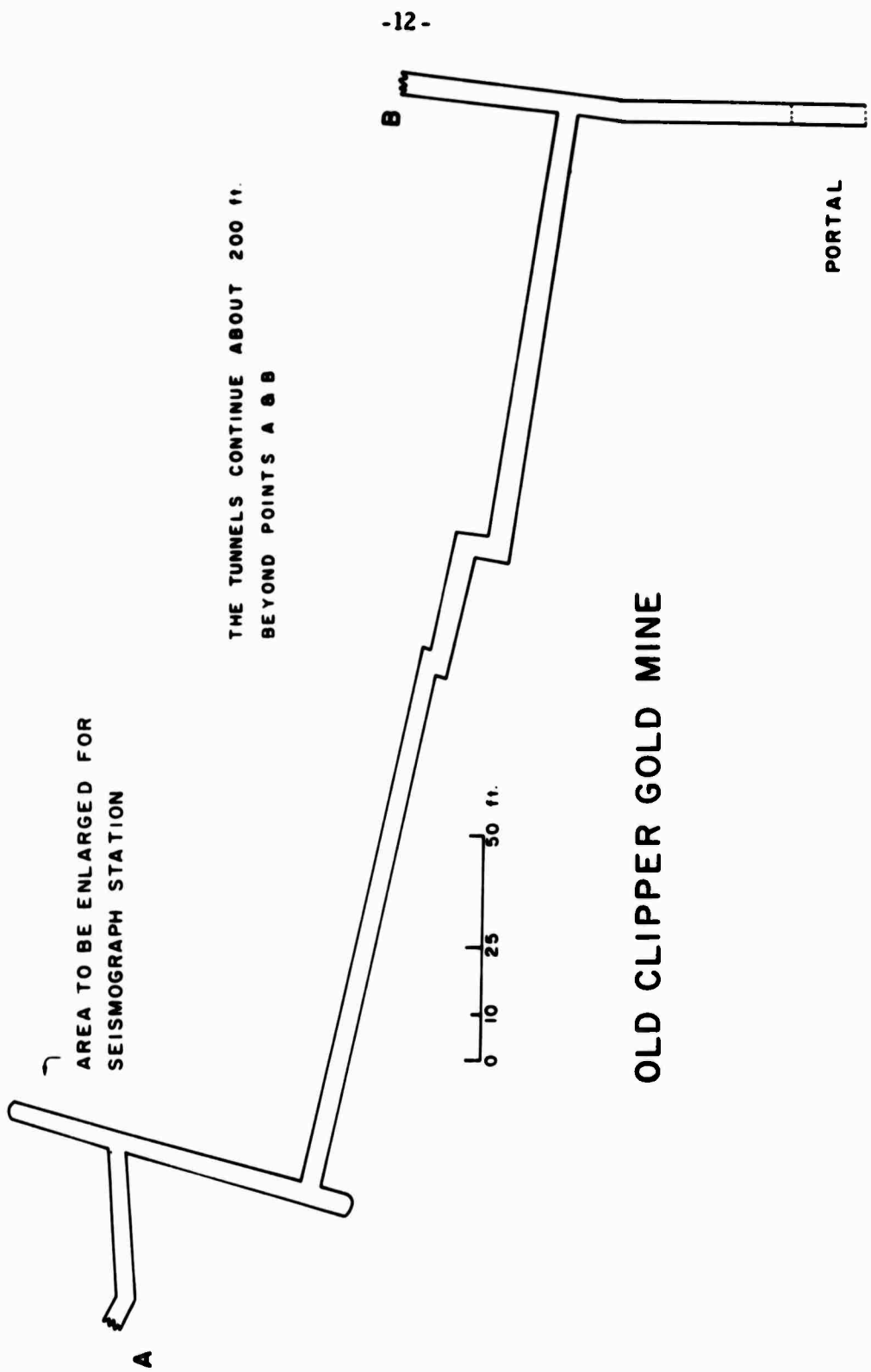


Figure II-1: Plan view of the Old Clipper Gold Mine with the area to be enlarged for the seismograph station indicated. The tunnel continues approximately 200 ft beyond points A and B.

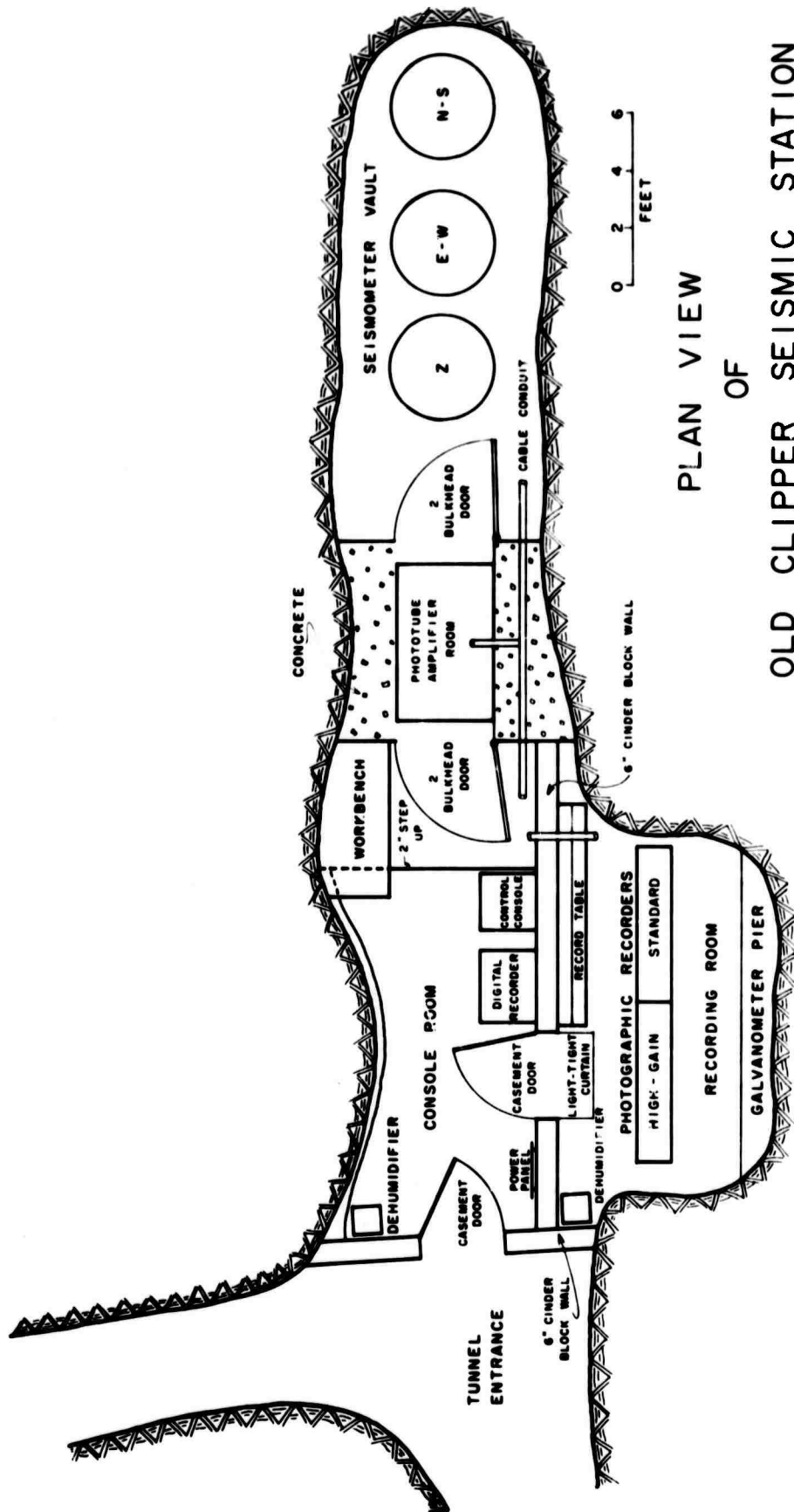


Figure II-2: Plan view of the Old Clipper Seismograph Station.

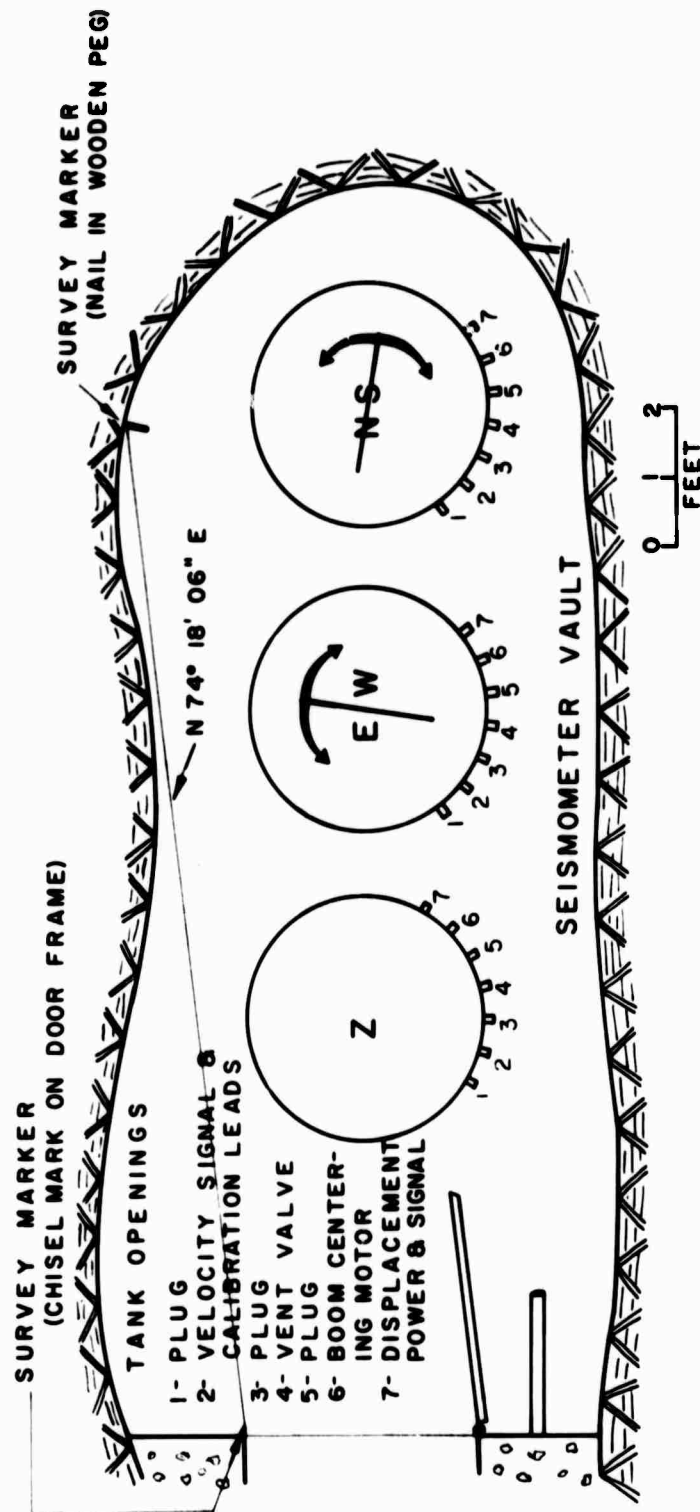


Figure II-3: Plan view of Seismometer Vault showing:
a) Position of seismometer pressure tanks,
b) Position of markers of surveyed reference for North-South axis.

improve the seal, all surfaces of the plug and 30 cm (12 in.) of the surrounding rock were coated with epoxy paint.

In preparing the seismometer chamber floor for pouring concrete, all loose rock was removed with the aid of hammer and chisel. Extreme care was taken to remove pebbles and sand grains; a fire hose and compressed air were used for this purpose. The resulting bedrock surface, although clean, was very irregular. A commercial ready-mix concrete was pumped from the tunnel entrance for the seismometer pier, which varied in thickness from 5 to 40 cm (2 to 16 in.). A firm bond to the bedrock was ensured by hand-vibrating the concrete. No reinforcing devices were placed in the concrete.

The seismometer tanks were initially prestressed by distorting the base into a dome .9 cm (3/8 in.) high at the center. Each tank was then anchored to the bedrock with 1.8 cm (3/4 in.) cadmium-plated steel rods and roofbolt anchors in holes drilled through the pier to bedrock. The void under each tank was carefully filled with "Sakrete" mortar mix, and the tank bottoms were pulled down on this slurry being careful to extrude mortar evenly around the bottom.

The seismometer pier was surveyed for a north-south line to $\pm 0.5^\circ$ and permanently marked by a nail in a peg on one side and by a chisel mark in the edge of the bulkhead door on the other.

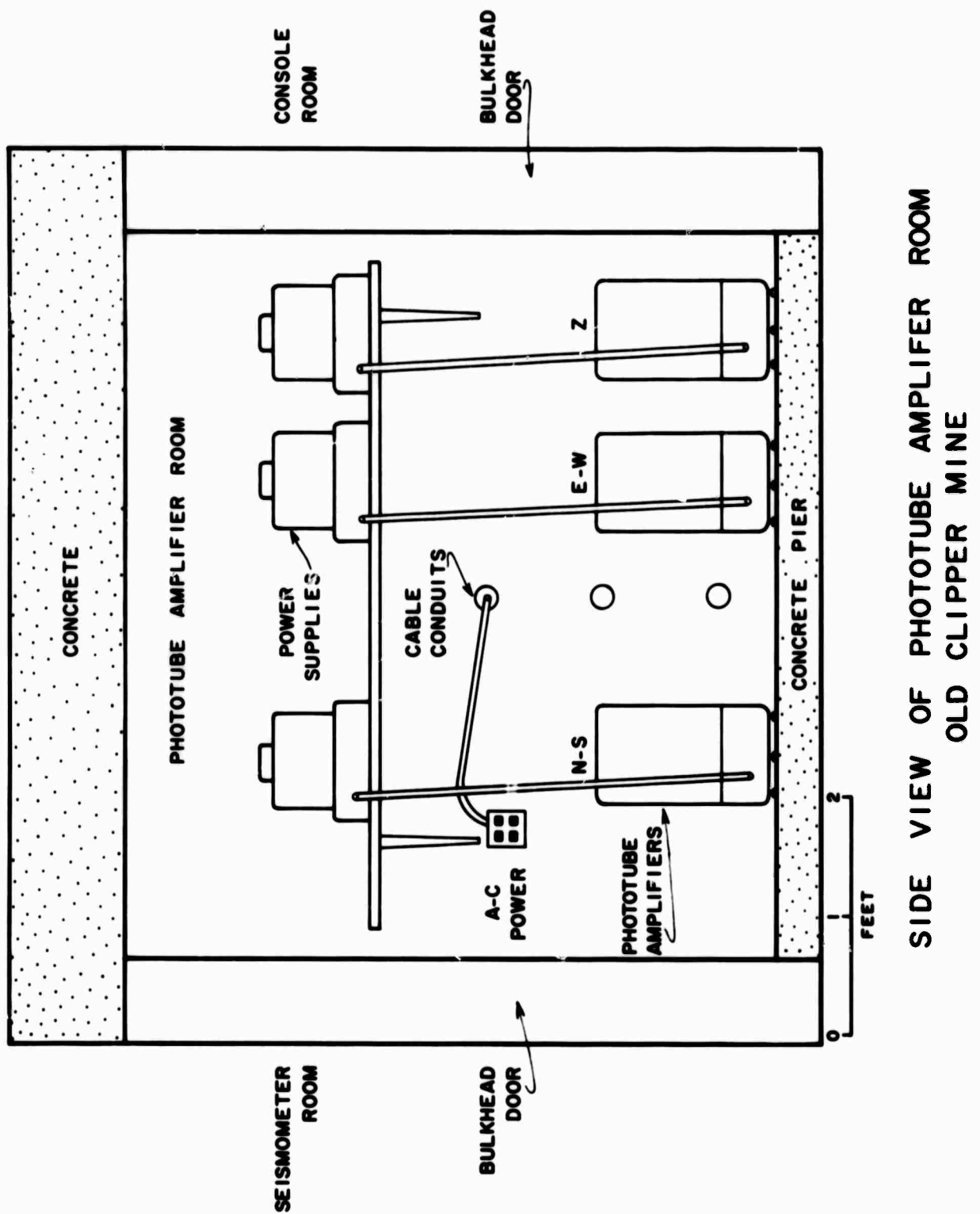


Figure II-4: Cross-sectional view of the Phototube Amplifier Room (looking south).

Figure II-3 shows the alignment of the seismometers and the position of the cable conduits in the tank. A series of wooden pegs were placed in the rock wall to serve as a cable trellis.

The P. T. A. room houses the phototube amplifier and their power supplies (Figure II-4). All concrete surfaces in this room are coated with epoxy paint.

RECORDING AND CONSOLE ROOMS

The recording room (Figure II-2) is separated from the console room by a cinder block wall. A black-out curtain-covered alcove in the recording room permits access to the recorders without turning off the console room lights. The galvanometer pier is 3 m. long, .6 m. high, and .4 m. deep (120" x 24" x 16") concrete block that was poured against the back wall and capped with mortar mix. The two three-drum photographic recorders are mounted on adjustable angle-iron benches. Cabling is mounted on pegs driven in the rock wall. All cable conduits were made light-tight.

The console room houses the power distribution panel, digital acquisition system, control console, displacement transducer power supply, workbench, and storage shelves.

CABLES

Details of cables used for the installation are given in Table 1. To preserve the pressure integrity in the seismometer and P. T. A. rooms, all the cables are potted in "Scotch cast" resin and routed through the 5 cm. (2 in.) galvanized pipe conduits in the concrete plug. The cables enter the console and recording rooms through similar 5 cm. (2 in.) pipe conduits. These entry points are sealed light- and air-tight using "Duxseal" compound.

TABLE I

CABLE DETAILS

CABLE #	DESCRIPTION		CABLE TYPE
1	Z Velocity Low Gain Signal	Seismo to Photorec	2CS
2	Z Primary Calibration	Seismo to Console	2CS
3	Z Secondary Calibration	Seismo to Photorec	2CS
4	Z Velocity High Gain Signal	Seismo to P. T. A.	2CS
5	Z Displacement Signal/Boom Center Monitor	Seismo to Console	2CST
5c	Z Displacement Signal	Console to Digital	2CST
6	Z Displacement Transducer Power Supply	P. T. A. to Seismo	3CST
7	Z Boom Centering Motor	Console to Seismo	2CST
8	Z Velocity High Gain Signal	P. T. A. to Digital	2CST
9	Z Velocity High Gain Signal	P. T. A. to Photorec	2CST
10	Z P. T. A. Galvo Center Monitor	P. T. A. to Console	2CST
11	E-W Velocity Low Gain Signal	Seismo to Photorec	2CS
12	E-W Primary Calibration	Seismo to Console	2CS
13	E-W Secondary Calibration	Seismo to Photorec	2CS
14	E-W Velocity High Gain Signal	Seismo to P. T. A.	2CS
15	E-W Displacement Signal/Boom Center Monitor	Seismo to Console	2CST
15c	E-W Displacement Signal	Console to Digital	2CST

TABLE I (Continued)

CABLE #	DESCRIPTION		CABLE TYPE
16	E-W Displacement Transducer Power Supply	P. T. A. to Seismo	3CST
17	E-W Boom Centering Motor	Console to Seismo	2CST
18	E-W Velocity High Gain Signal	P. T. A. to Digital	2CST
19	E-W Velocity High Gain Signal	P. T. A. to Photorec	2CST
20	E-W P. T. A. Galvo Center Monitor	P. T. A. to Console	2CST
21	N-S Velocity Low Gain Signal	Seismo to Photorec	2CS
22	N-S Primary Calibration	Seismo to Console	2CS
23	N-S Secondary Calibration	Seismo to Photorec	2CS
24	N-S Velocity High Gain Signal	Seismo to P. T. A.	2CS
25	N-S Displacement Signal/ Boom Center Monitor	Seismo to Console	2CST
25c	N-S Displacement Signal	Console to Digital	2CST
26	N-S Displacement Transducer Power Supply	P. T. A. to Seismo	3CST
27	N-S Boom Centering Motor	Console to Seismo	2CST
28	N-S Velocity High Gain Signal	P. T. A. to Digital	2CST
29	N-S Velocity High Gain Signal	P. T. A. to Photorec	2CST
30	N-S P. T. A. Galvo Center Monitor	P. T. A. to Console	2CST
31	Z P. T. A. Galvo Centering Motor	Console to P. T. A.	2CST

TABLE I (Continued)

CABLE #	DESCRIPTION	CABLE TYPE
32	E-W P.T.A. Galvo Centering Motor Console to P. T. A.	2CST
33	N-S P.T.A. Galvo Centering Motor Console to P. T. A.	2CST

Cables A thru H are spares; begin in seismometer room, terminate in photorecording room

Cables I and J are spares; begin in P. T. A. room, terminate in photo recording room.

Notes: (1) Cable Type

2CS 2 Conductor Solid (#18 wire)

2CST 2 Conductor Stranded (#16 wire)

3CST 3 Conductor Stranded (#16 wire)

All cables with milar shield and separate earth conductor.

(2) Cables 13C, 14C, 15C:

"C" denotes a cable connecting the displacement transducer output of the seismometer from the control console to the digital system enabling the displacement signal to be digitally recorded as well as to be the monitor for boom position.

TABLE I (Continued)

Notes (Cont. d):

(3) Abbreviations for end positions of cable runs:

Seismo	- Seismometer Room
P. T. A.	- Phototube Amplifier Room
Photorec	- Photographic Recording Room
Console	- Control Console in Control Room
Digital	- Digital Acquisition System in Control Room

(4) All 110 V is #10-3 plastic covered cable.

III: STATION FACILITIES

AVAILABLE COMMERCIAL POWER

Voltage: 240 V

Frequency: 60 Hz

Reliability: The input line voltage to the distribution panel in the console room varies less than 5% from the nominal line voltage of 240 V. No test equipment was available to measure the nominal 60 Hz frequency of the line, but a careful examination of the length of minute on the photographic records indicates that there is no apparent variation in frequency (less than $\pm 5\%$).

Occasional power failures of varying deviation are known to occur. Thirteen power failures occurred during the last 60 days of 1970; the lengths varied from a few seconds to twenty minutes. An uninterruptable power supply will be installed in the spring of 1971.

Because of the low temperature in the seismograph station, it is necessary to operate an electric heater to keep the recording room warm enough to prevent the dehumidifier from freezing up. The temperature conditions cause the heater to operate with a 20 minute

on-off-on cycle. This causes a 3.5 volt rise or drop on the 120 V. line every 10 minutes. This does not seem to effect the system.

AVAILABLE TIME STANDARD

Time for the analog (photographic) records is taken from a crystal oscillator time standard in the digital data acquisition system. A Specific Products Model WVTR receiver was installed in the tunnel with a tuned antenna oriented NW to SE on a ridge above the tunnel entrance. Radio reception of WWV, Fort Collins, and WWVH, Honolulu, is poor. Arrangements are being made to have a time signal rent via telephone line from either the Geophysical Institute of the University of Alaska or the College Observatory of National Ocean Survey.

STATION TEMPERATURE AND HUMIDITY

There is no equipment in the seismometer vault to record or control pressure and temperature (e. g. no light bulbs as heat sources). There is a dehumidifier in the recording room and in the console room; in addition to the dehumidifier, a heater is required in the recording room.

Prior to installation the temperature in the area of the seismic station was fairly stable year-round at about 5°C (40°F). Four

months after installation, the console room temperature is 24°C (74°F); humidity is about 60%; and the tunnel temperature is 8°C (46°F).

Significant comment on the affects of meteorological phenomena on this station will have to await the installation of additional meteorological instrumentation.

BACKGROUND NOISE

The microseismic activity is associated with meteorological phenomena, particularly low pressure fronts and storms in the Gulf of Alaska. Predominant microseisms have periods of 6 to 8 and 18 seconds. The greatest activity occurs during the winter months. The following table provides an idea of the microseismic level at the College (World-Wide Standard Seismograph Network) station (data provided by personnel at College Observatory):

Microseism	Summer	Winter
Disturbed day	5.6 micron 8 sec	15 micron 6 sec
Quiet day	0.4	1.5

OTHER INSTRUMENTS IN OPERATION

There are no other seismic or geophysical instruments operating at the Old Clipper Mine station. The WWSSN station, COL, at College is approximately 10 km east of the mine, where there are

three short-period ($T_0 = 1$ sec) Benioff variable-reluctance seismometers and three long-period ($T_0 = 15$ sec) Press-Ewing seismometers. The magnification of the components are:

SP	Z	:	100,000
SP	N-S	:	100,000
SP	E-W	:	100,000
LP	Z	:	1,500
LP	N-S	:	1,500
LP	E-W	:	1,500

IV: INSTRUMENTATION

The details of the system instrumentation are given in the Lamont-Doherty Geological Observatory Technical Report, entitled "High-Gain, Long-Period Seismograph Station Instrumentation". The complete system is shown in Figures IV-1 and IV-2. Amendments to the system and specific details that pertain only to the Fairbanks installation are given below. All tests and calibrations were performed remotely from the control room. A set of magnification curves is given in Appendix II. These curves are representative of the station as of 1 March 1971 and are subject to change dependent upon variations in noise at the station. Photographs of the Fairbanks installation are given in Appendix I.

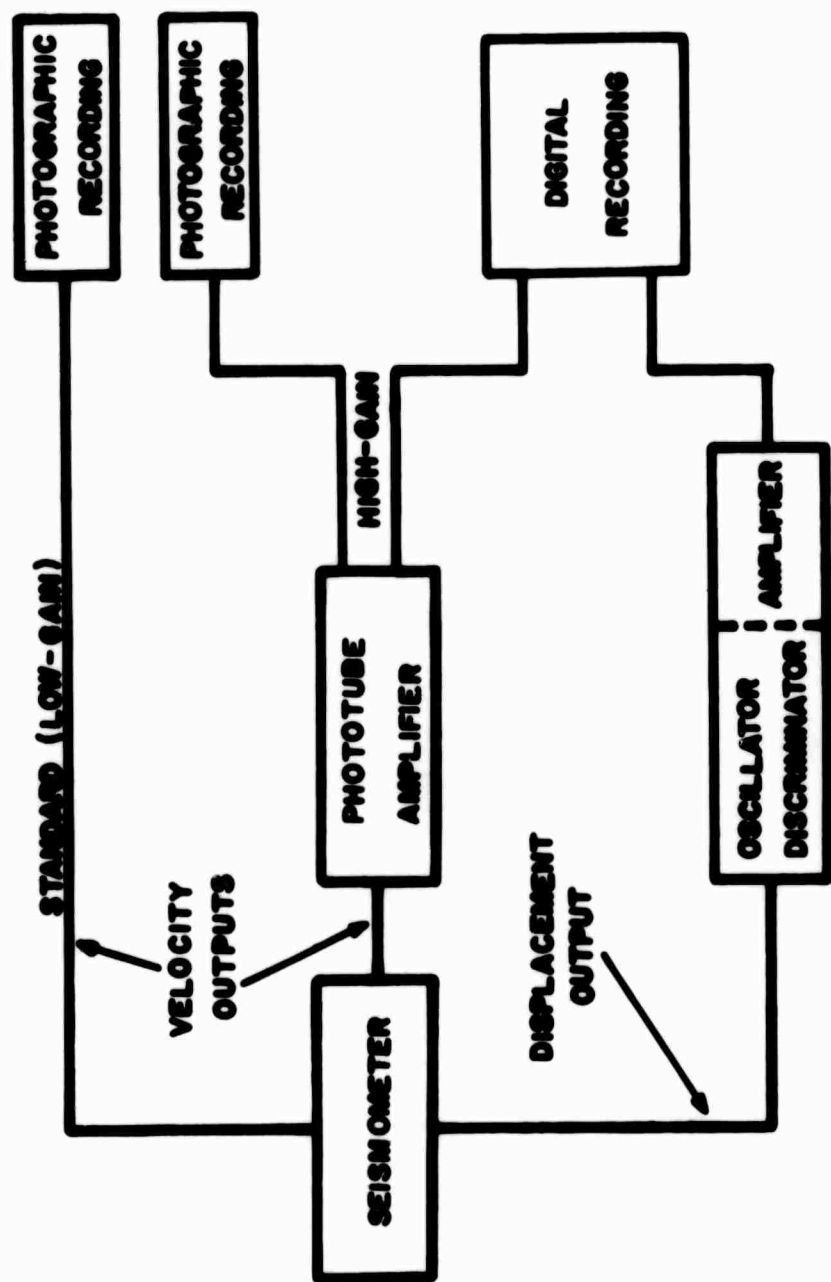


Figure IV 1: Schematic block diagram of the high-gain, long-period seismograph system.

Figure IV-2: Detailed diagram of the high-gain, long-period seismograph system. This figure is a fold out at the end of this report.

AMENDMENTS TO SYSTEM DIAGRAM:

STATION: Fairbanks, Alaska

1. The following parts are not at this station:

1. D. G. O. Part Numbers: 1103, 1115, 2501, 3270, 3271, 3410-1, 3500, 3501, 4104, 4104, 5100 (only 2, not 3), 5101, 7023, 7024, 8038, 8039, and 8040.
2. Voltage regulator (#3270) not in operation: A. C. power from power distribution panel (#3424) direct to specific components.
3. Auto transformer (#3410-2) used to drop commercial power from 240 V to 120 V at station distribution panel.
4. Radio (#3218) was installed at station to receive time signal. Reception has been extremely poor so the radio time signal will be replaced with a time signal brought in on the telephone line from University of Alaska receiver in spring of 1971.
5. Only two bulkhead doors (#5100) were installed (Figure II-1).
6. Filter galvanometers (#4350) are in operation.

VERTICAL

Seismometer:

Serial Number: #7

Free Period: 30 seconds

Magnets: Lower - before attachment: 2450 gauss
Upper - before attachment: 2425 gauss

Coil Resistances: Standard signal: 560 ohm
Hi-Gain signal: 560 ohm
Primary Calibration: 2 ohm
Secondary Calibration: 2 ohm

CDRX (Critical for one signal coil): 3,500 ohm

Electromechanical Constant, G:

Standard Signal Coil 1: $R^1 = 88K \text{ ohm}$
 $V = 1.43 \text{ volts}$
 $G = 119.5 \text{ newtons amp}^{-1}$

Hi-Gain Signal Coil 4: $R^1 = 82K \text{ ohm}$
 $V = 1.43 \text{ volts}$
 $G = 112.7 \text{ newtons amp}^{-1}$

Primary Calibration $R^1 = 24.5 \text{ ohm}$
Coil 2: $V = 1.43 \text{ volts}$
 $G = .033 \text{ newtons amp}^{-1}$

Secondary Calibration	R^1	=	23	ohm
Coil 3:	V	=	1.43	volts
	G	=	.029	newtons amp ⁻¹

Cable Resistances:

Cable # 1	:	1.0 ohm
Cable # 2	:	1.0 ohm
Cable # 3	:	1.0 ohm
Cable # 4	:	1.0 ohm

Lo-Gain Galvanometer:

Serial Number:	165
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

P. T. A. Galvanometer:

Serial Number:	104
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

Hi-Gain Recording Galvanometer:

Serial Number: 4200

Free Period: .33 seconds

CDRX Set: 120 ohm

Damping: 1.0 critical

Current Sensitivity: amp mm⁻¹ at 1 meter

Gain Resistor: 200K ohms

Component Magnification:

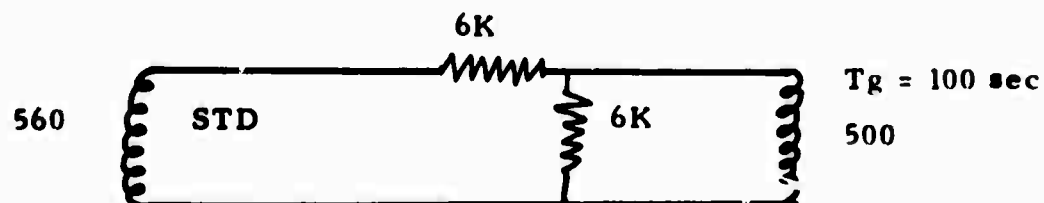
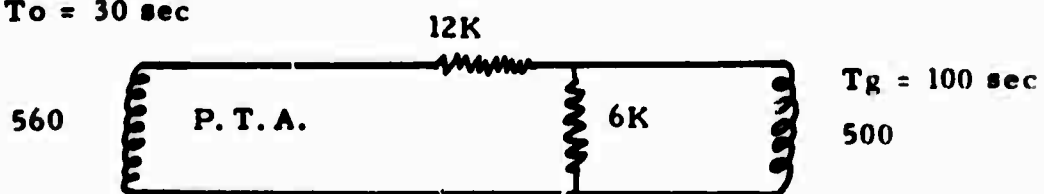
Lo-Gain: 7.7 at 25 seconds

Hi-Gain: 106K at 34 seconds

Remarks:

The final settings of the L-pad attenuators are as follows:

To = 30 sec



NORTH - SOUTH

Seismometer:

Serial Number:	#211		
Free Period:	30 seconds		
Magnets:	Level side:	2400	gauss
	Non-level side:	2400	gauss
Coil Resistance:	Standard signal:	560	ohm
	Hi-Gain signal:	560	ohm
	Primary Calibration:	2	ohm
	Secondary Calibration:	2	ohm
CDRX (Critical for one signal coil):	5,900	ohm	

Electromechanical constant, G:

Standard Signal Coil 21:	R^1	=	201K	ohm
	V	=	1.42	volts
	G	=	131.8	newtons amp⁻¹
Hi-Gain Signal Coil 24:	R^1	=	205K	ohm
	V	=	1.42	volts
	G	=	129.2	newtons amp⁻¹
Primary Calibration	R^1	=	59	ohm
Coil 22:	V	=	1.42	volts
	G	=	.041	newtons amp⁻¹

Secondary Calibration	R^1	=	58	ohm
Coil 23:	V	=	1.42	volts
	G	=	.038	newtons amp ⁻¹

Cable Resistances:

Cable # 21	:	1.0 ohm
Cable #22	:	1.0 ohm
Cable #23	:	1.0 ohm
Cable #24	:	1.0 ohm

I.o-Gain Galvanometer:

Serial Number:	121
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

P. T. A. Galvanometer:

Serial Number:	156
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

Hi-Gain Recording Galvanometer:

Serial Number: 4175

Free Period: . 33 seconds

CDRX Set: 120 ohm

Damping: 1. 0 critical

Current Sensitivity: amp mm⁻¹ at 1 meter

Gain Resistor: 300K ohms

Component Magnification:

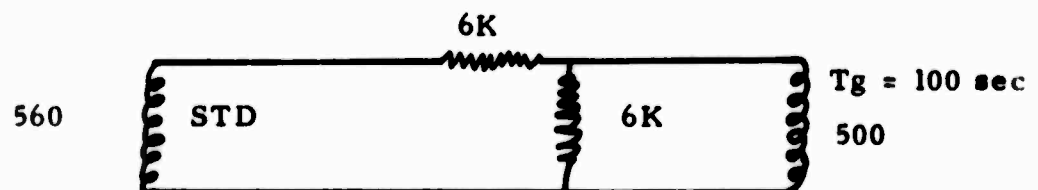
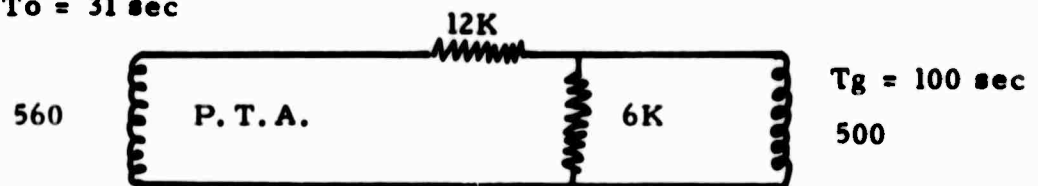
Lo-Gain: 5. 7K at 34 seconds

Hi-Gain: 96K at 45 seconds

Remarks:

The final settings of the L-pad attenuators are as follows:

To = 31 sec



EAST - WEST

Seismometer:

Serial Number: #233

Free Period: 30 seconds

Magnets: Level side: 2400 gauss
Non-level side: 2400 gauss

Coil Resistances: Standard signal: 560 ohm
Hi-Gain signal: 560 ohm
Primary Calibration: 2 ohm
Secondary Calibration: 2 ohm

CDRX (Critical for one signal coil): 5,900 ohm

Electromechanical constant, G:

Standard Signal Coil 11: $R^1 = 185K$ ohm
 $V = 1.42$ volts
 $G = 143.6$ newtons amp⁻¹

Hi-Gain Signal Coil 14: $R^1 = 178K$ ohm
 $V = 1.42$ volts
 $G = 149$ newtons amp⁻¹

Primary Calibration $R^1 = 54$ ohm
Coil 12: $V = 1.42$ volts
 $G = .045$ newtons amp⁻¹

Secondary Calibration	R^1	=	53	ohm
Coil 13:	V	=	1.42	volts
	G	=	.046	newtons amp ⁻¹

Cable Resistances:

Cable # 11	:	1.0 ohm
Cable # 12	:	1.0 ohm
Cable # 13	:	1.0 ohm
Cable # 14	:	1.0 ohm

Lo-Gain Galvanometer:

Serial Number:	117
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

P. T. A. Galvanometer:

Serial Number:	123
Free Period:	100 seconds
CDRX Set:	3,000 ohm
Damping:	.7 critical
Current Sensitivity:	amp mm ⁻¹ at 1 meter

Hi-Gain Recording Galvanometer:

Serial Number: 3028

Free Period: .33 seconds

CDRX Set: 120 ohm

Damping: 1.0 critical

Current Sensitivity: amp mm⁻¹ at 1 meter

Gain Resistor: 300K ohms

Component Magnification:

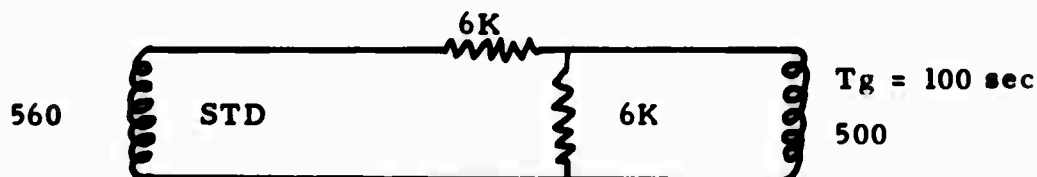
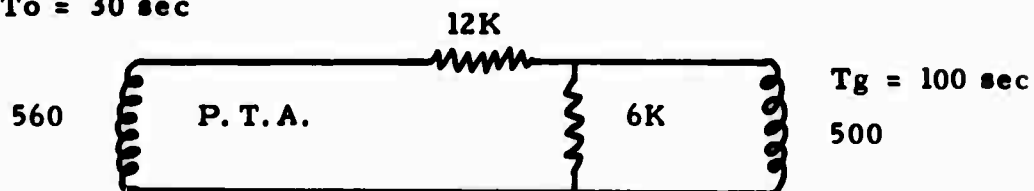
Lo-Gain: -- at -- seconds

Hi-Gain: -- at -- seconds

Remarks:

The final settings of the L-pad attenuators are as follows:

To = 30 sec



PHOTOGRAPHIC RECORDERS:

Low-Gain:	Rotation Speed:	7.5 mm/minute
	Translation Speed:	10 mm/revolution
High-Gain:	Rotation Speed:	7.5 mm/minute
	Translation Speed:	10 mm/revolution

DISPLACEMENT TRANSDUCERS:

Vertical:	Serial Number:	3881
	Sensitivity:	
	Range of Linearity ($\pm 0.1\%$):	
North-South:	Serial Number:	3898
	Sensitivity:	
	Range of Linearity ($\pm 0.1\%$):	
East-West:	Serial Number:	3878
	Sensitivity:	
	Range of Linearity ($\pm 0.1\%$):	

DIGITAL DATA ACQUISITION SYSTEM:

Station I. D. : 03

Input Channels	Written on tape	Sampling Rate Samples per Second	Instrument
1	Yes	One sample per second	Z velocity
2	Yes	One sample per second	N-S velocity
3	Yes	One sample per second	E- W velocity
4	No		
5	No		
6	No		
7	No		
8	No		
9	No		
10	No		Test Channel
11	Yes	One sample per 5 sec.	Z displacement
12	Yes	One sample per 5 sec.	N-S displacement
13	Yes	One sample per 5 sec.	E- W displacement
14	No		
15	No		
16	No		

ACKNOWLEDGEMENTS

We wish to thank Jack Townsend and the other staff members of the College Observatory of the National Ocean Survey for their logistic support during the installation of this station. We also wish to acknowledge the logistic support and continued interest of Lloyd Lounsbury, Herb Mann, and George Lounsbury. The author wishes to thank George P. Hade, Jr., John M. W. Rynn, and Peter L. Ward for their advice and criticism during the preparation of this report and Tosi Matumoto and Lynn Sykes for critically reviewing it.

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APPENDIX I

PHOTOGRAPHS OF INSTALLATION



Plate 1: Explosive charges being set during the enlargement of the tunnel for the seismograph station. The cross-section is about 7'x7'. The rock is Birch Creek Schist, the local bedrock.



Plate 2: Cement slurry being prepared in the seismometer vault for setting the seismometer pressure tanks.

- Note:** a) 5 cm. cable conduits leaving the vault and entering the P. T. A. room
b) bulkhead door frames on both entries to the P. T. A. room
c) the control console in the control room beyond the P. T. A. room.

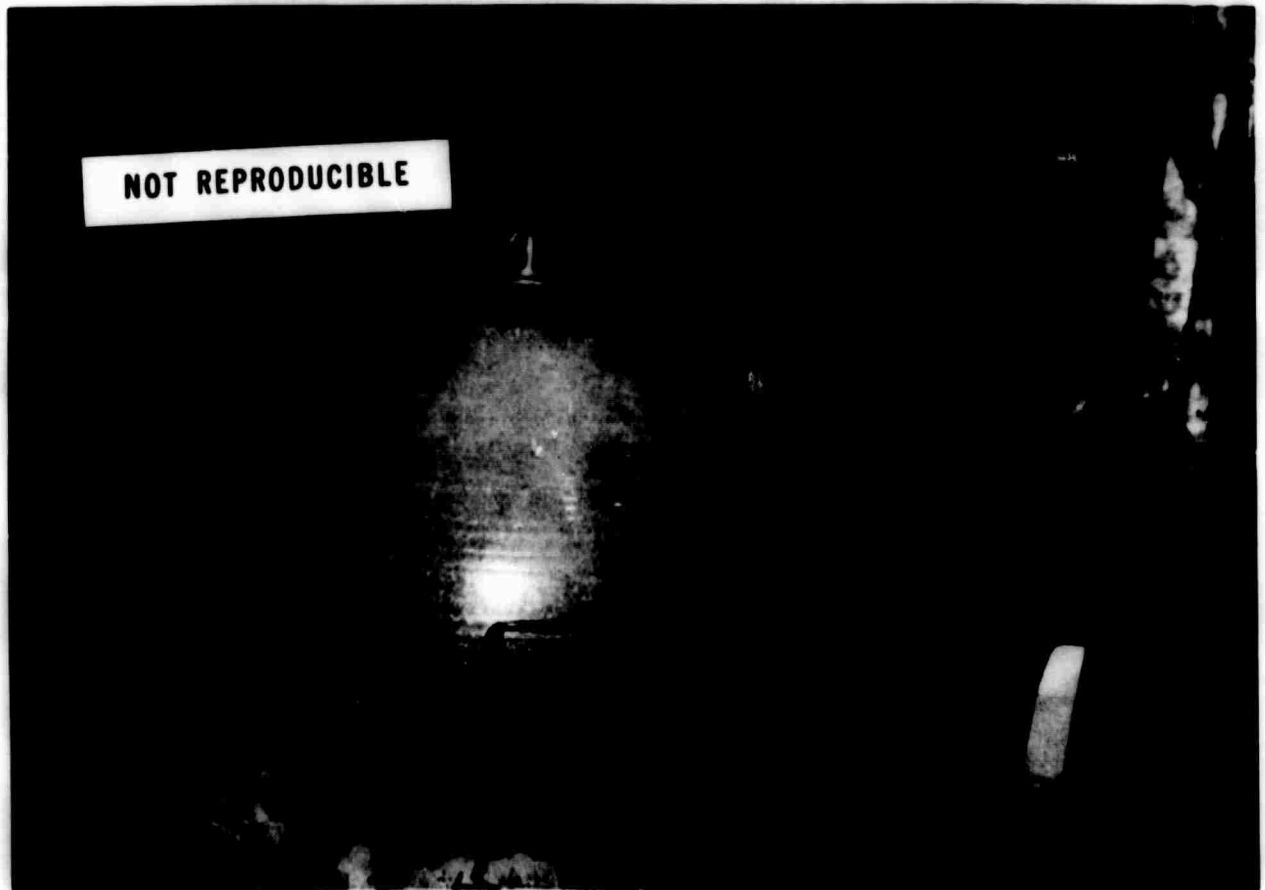


Plate 3: Sealing seismometer pressure tanks.

Note: a) heavy forged "c" clamps on tanks

b) the Marsh and Marine connectors on center tank

c) cable trellis along right wall

Upon completion of all instrumentation, the vault is sealed behind two bulkhead doors.

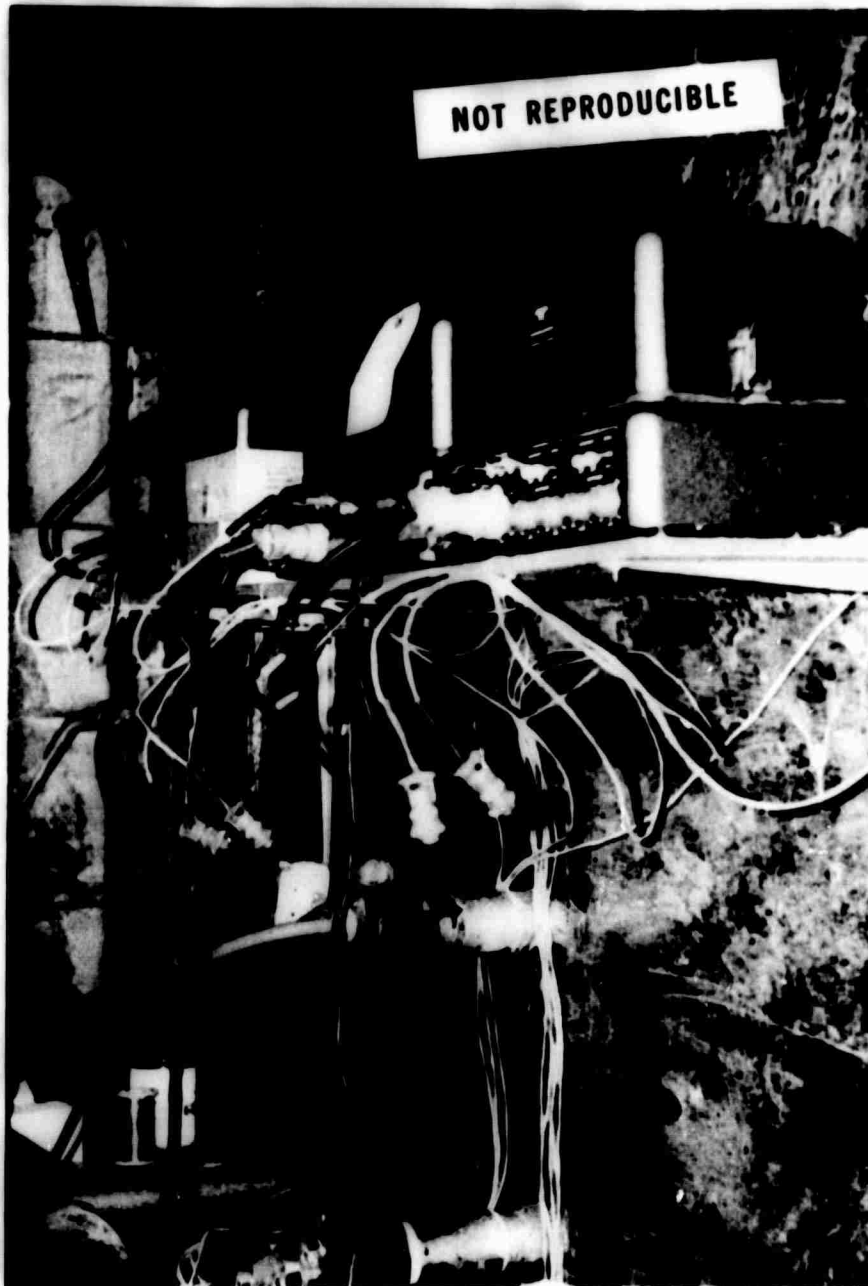


Plate 4: Phototube Amplifier Power Supplies
Note: pressure fitting on AC power line
at lower center of photograph ensures
pressure integrity of P. T. A. room.

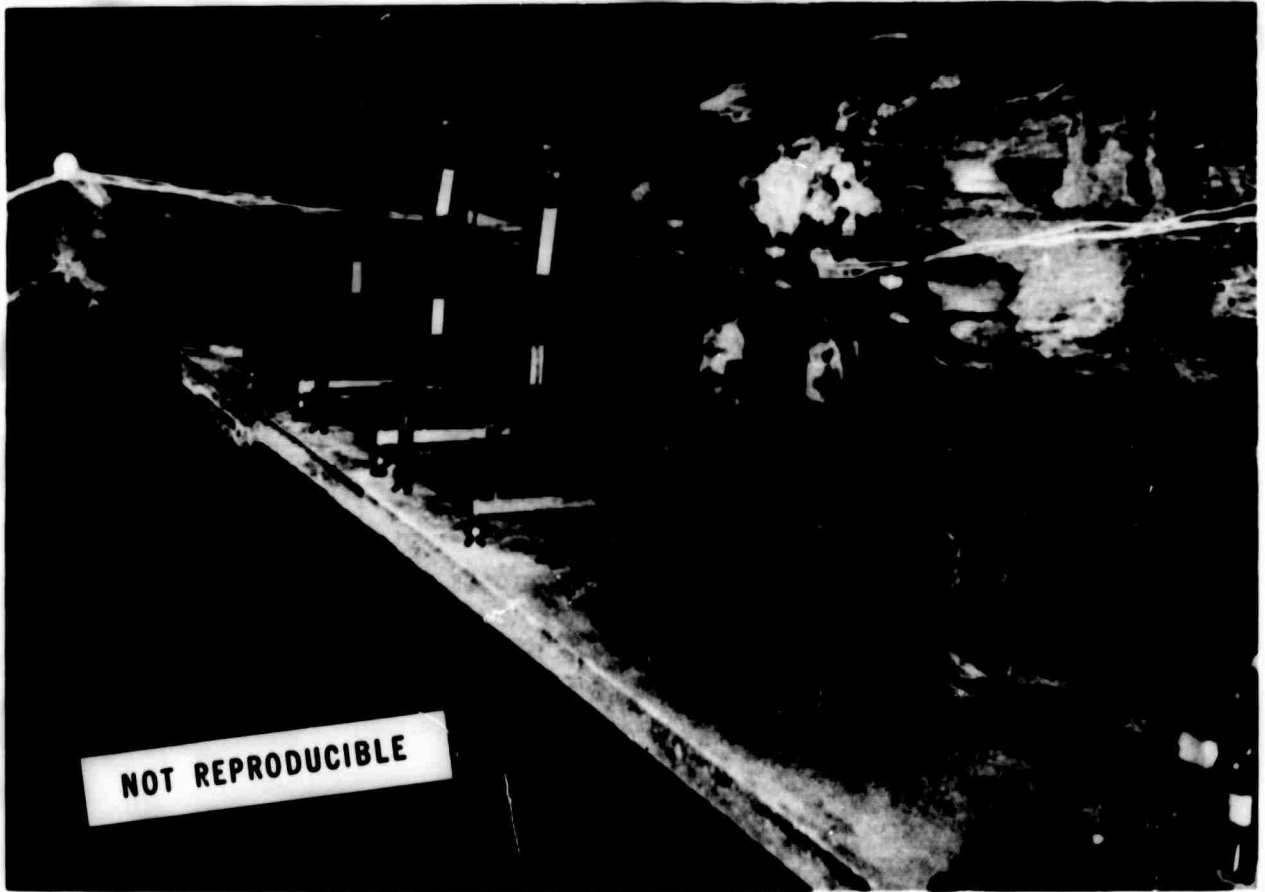
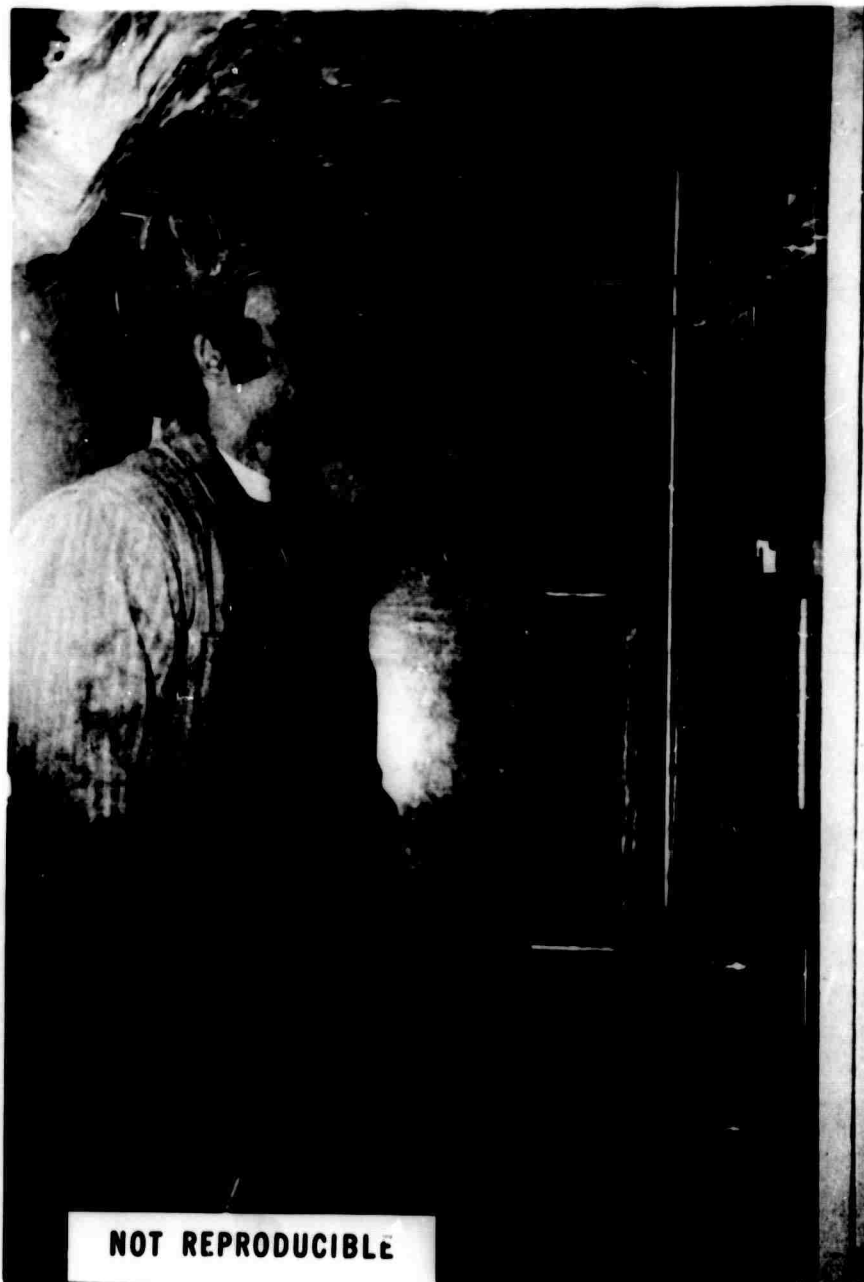


Plate 5: 100 sec. recording galvanometers and 6 sec. filter galvanometers (l. t. o. r.) placed on a concrete pier with a mortar mix cup. Wire exiting to the left of photograph go to control room; wire to the right go to short-period recording galvanometers.



**Plate 6: Control console and sealed bulkhead door
leading to P. T. A. room.**

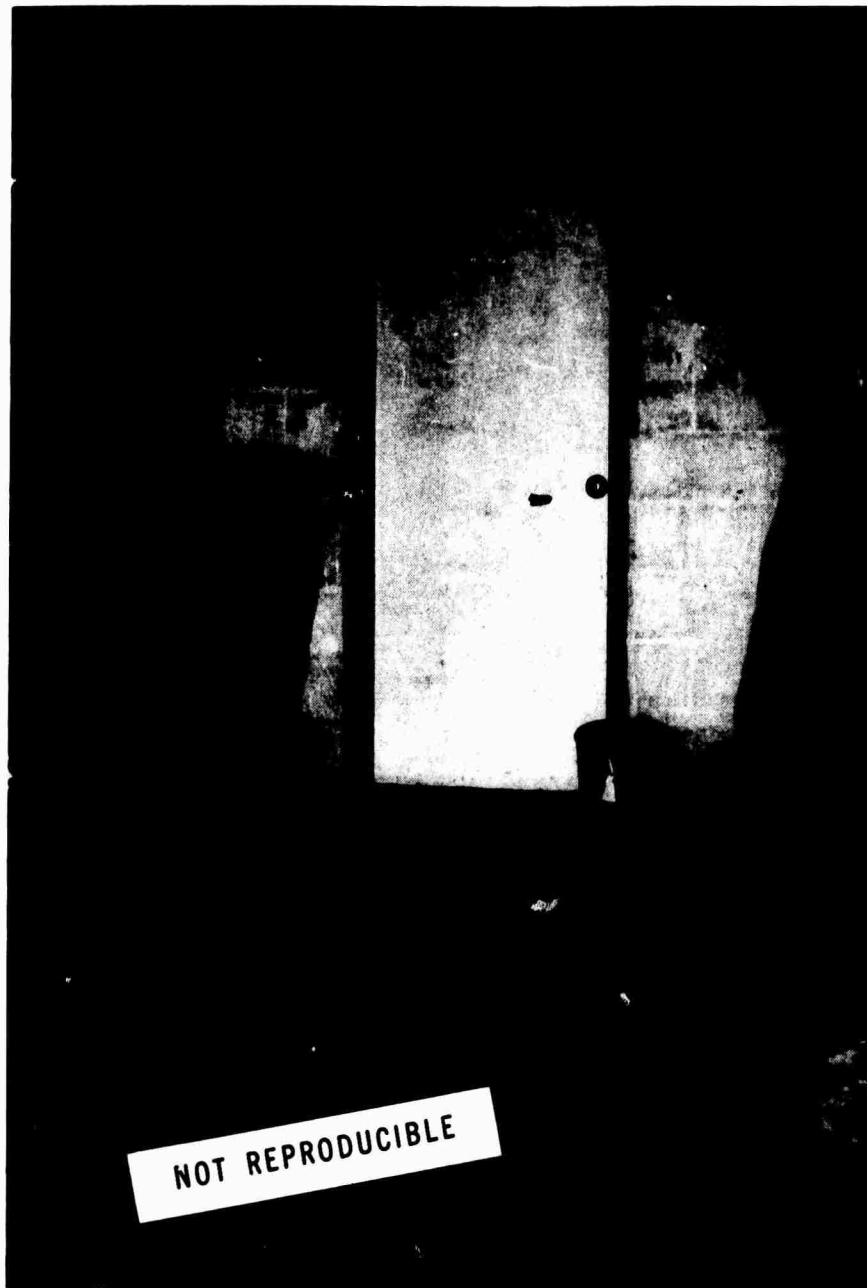
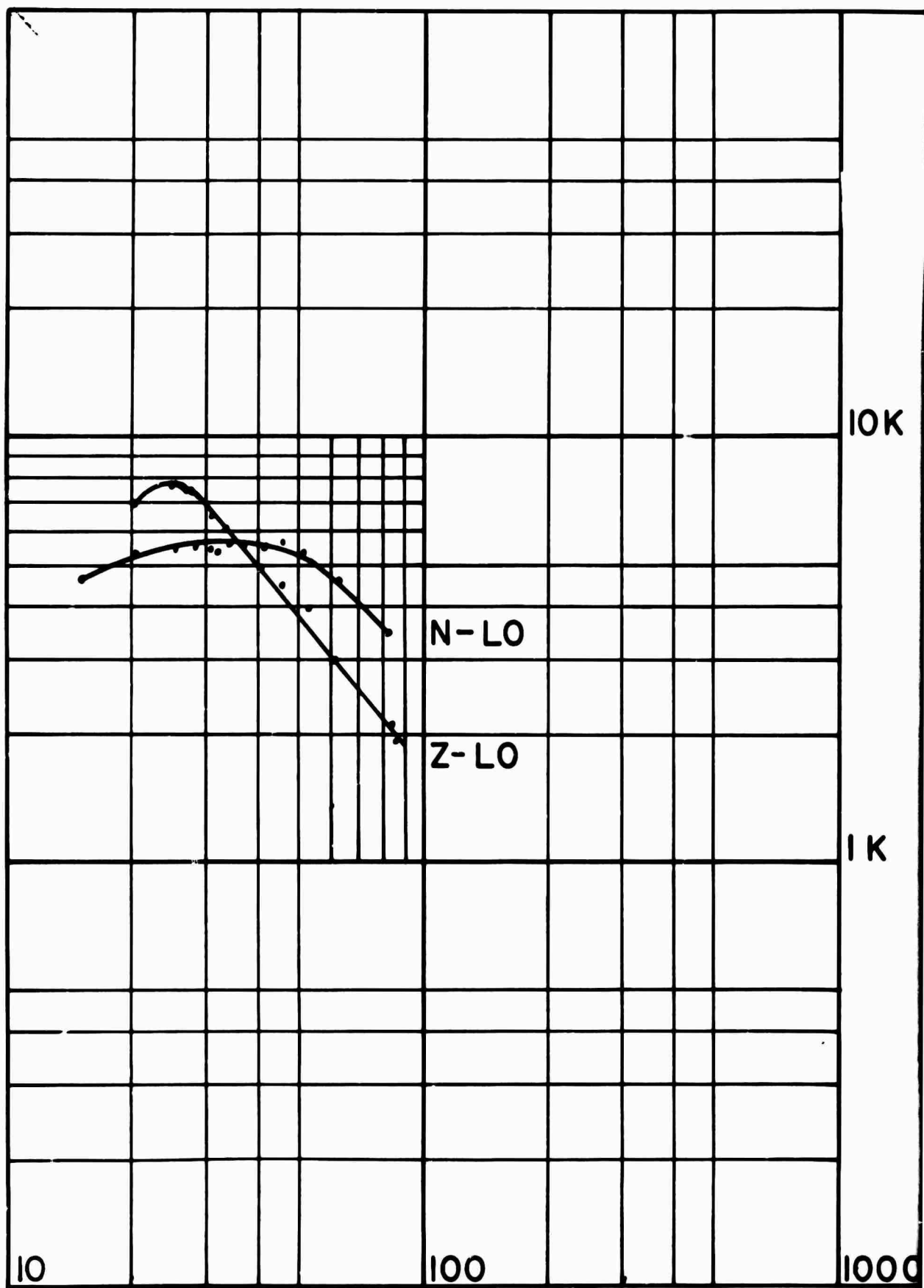


Plate 7: Entrance to Old Clipper Seismic Station.
Note: end of ore car tracks in foreground.

APPENDIX II

FREQUENCY RESPONSE CURVES



FREQUENCY RESPONSE OF
HIGH-GAIN, LONG-PERIOD
SEISMOGRAPH STATION AT
FAIRBANKS, ALASKA
STANDARD GAIN COMPONENTS

10K

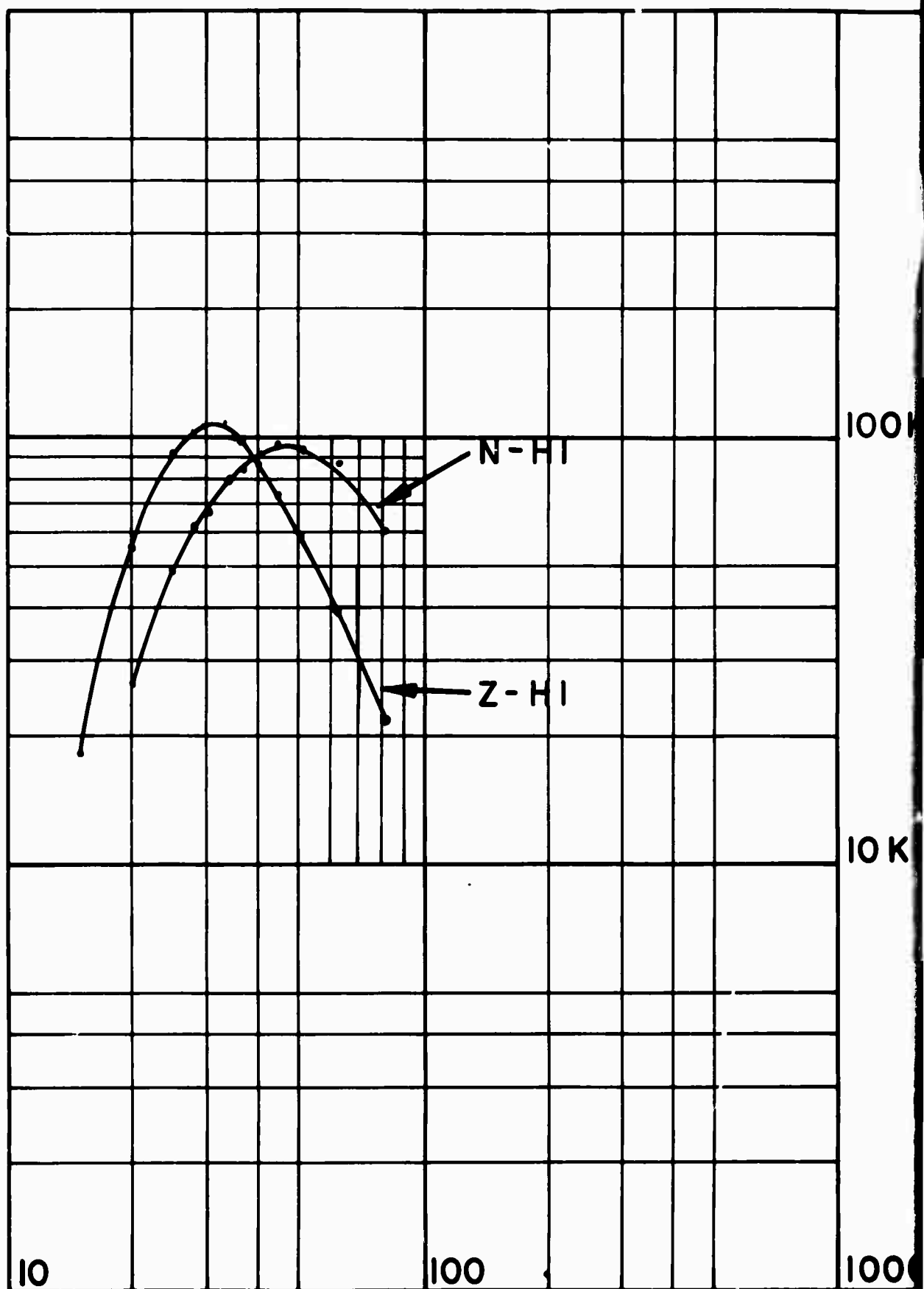
MAGNIFICATION

Z MAX. GAIN 7.7 K AT 25 SEC.
NS MAX. GAIN 5.7 K AT 34 SEC.
EW UNAVAILABLE AT
PRESENT DUE TO
TECHNICAL PROBLEMS

1K

1000 PERIOD IN SECONDS

B



11

FREQUENCY RESPONSE OF
HIGH-GAIN, LONG-PERIOD
SEISMOGRAPH STATION AT
FAIRBANKS, ALASKA
HIGH GAIN COMPONENTS

100K

MAGNIFICATION

10K

Z MAX. GAIN 106K AT 34 SEC.
NS MAX. GAIN 96K AT 45 SEC.
EW UNAVAILABLE AT
PRESENT DUE TO
TECHNICAL PROBLEMS

1000 PERIOD IN SECONDS

B

SEISMOMETER VAULT

P.T.A. ROOM

RECORDER ROOM

BULKHEAD
DOOR "3"
5100
OR
ROCK FACE

BULKHEAD
DOOR "2"
5100

BULKHEAD
DOOR "1"
5100

CASEMENT
DOOR
5700

DEHUMIDIFIER
4400

DEHUMIDIFIER
3600

QUAD
BOX
2400

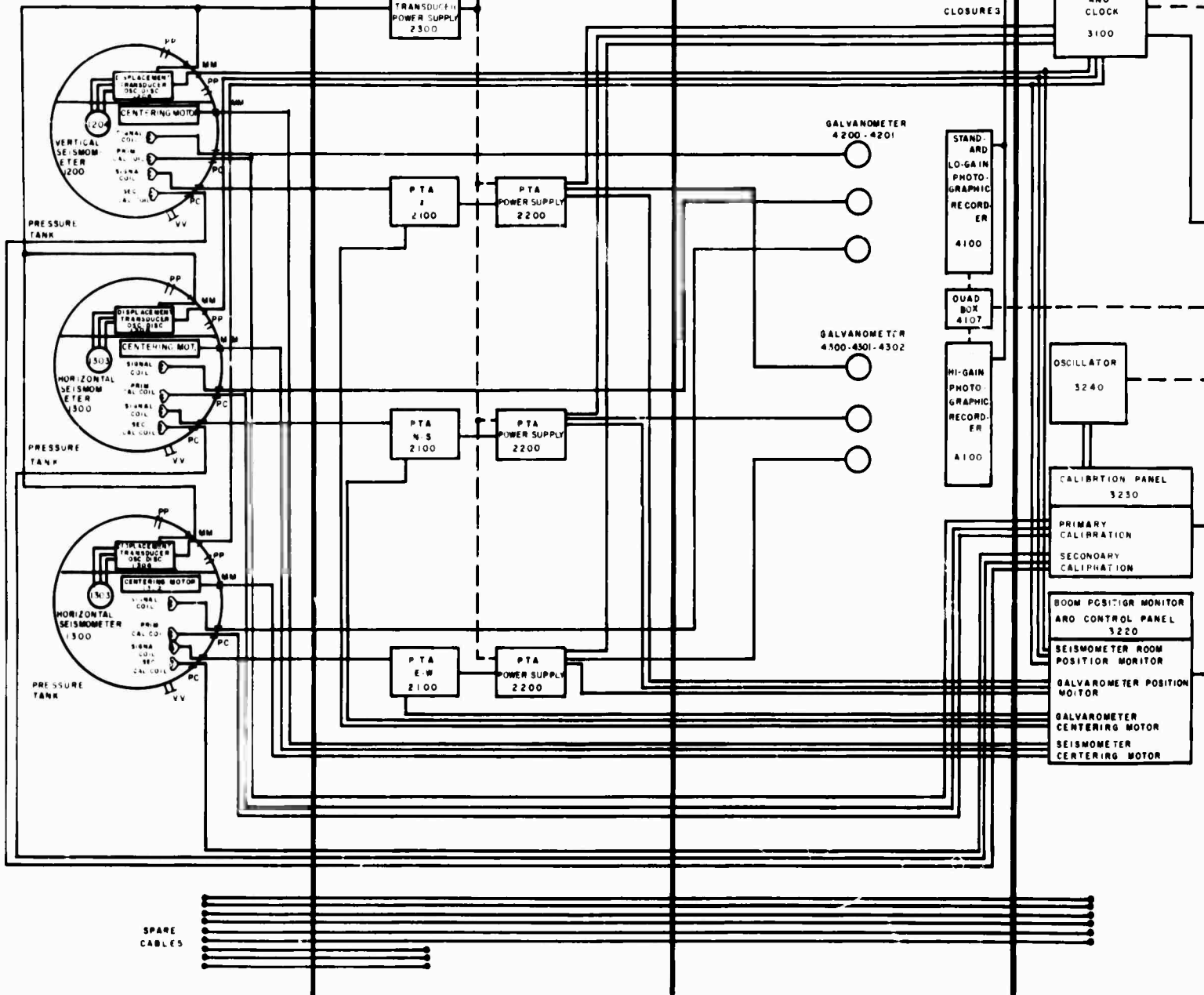
CABLES POTTED
IN 2" PIPE
5101

DISPLACEMENT
TRANSDUCER
POWER SUPPLY
2300

CABLES POTTED
IN 2" PIPE
5101

TIME
RELAY
CLOSURES

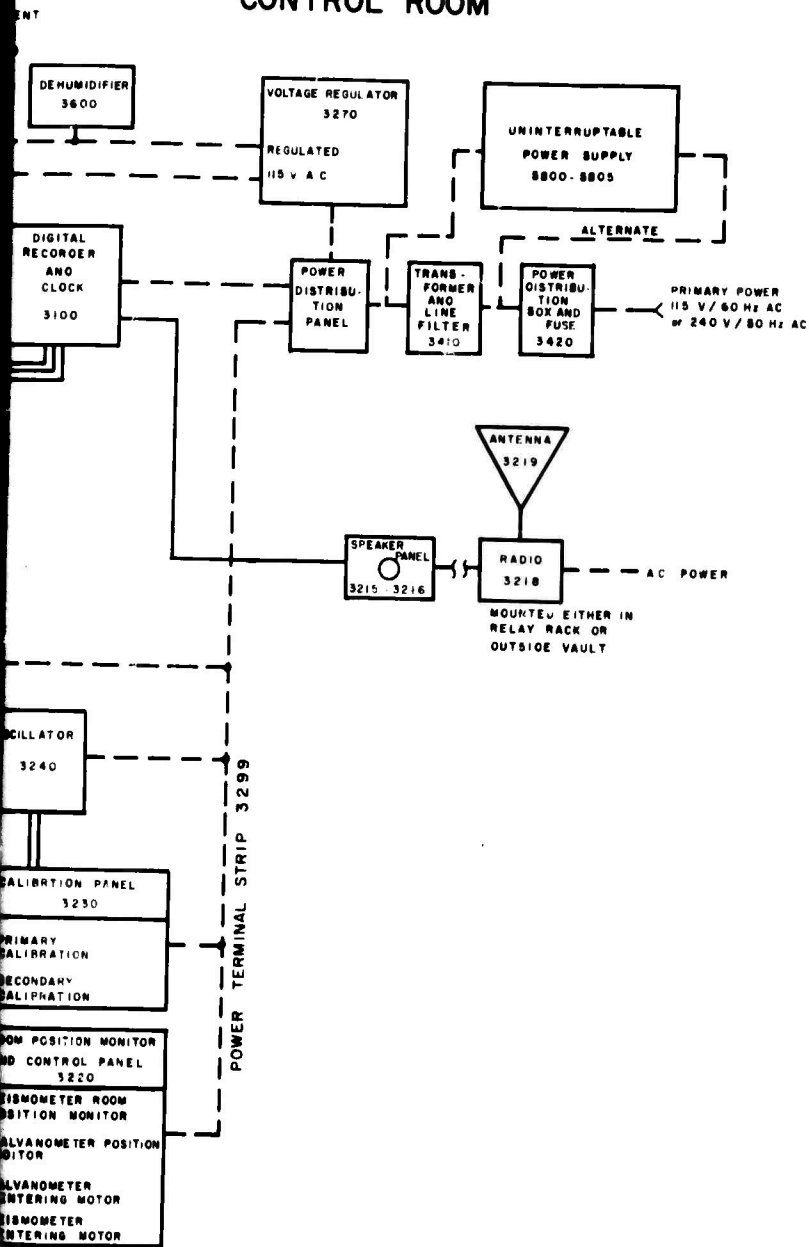
DIGITAL
RECORDER
AND
CLOCK
3100



SPARE
CABLES

2

CONTROL ROOM



CASEMENT
DOOR
3700

SYMBOLS USED ON PRESSURE TANK

VV	PRESSURE TANK VENT VALVE	1102
PC	POTTED CABLES	8208
MM	MARSH - MARINE CONNECTORS	1101 1103
PP	PIPE PLUG	1104

LAMONT - DOHERTY GEOLOGICAL
OBSERVATORY OF COLUMBIA UNIVERSITY

HIGH - GAIN BROAD - BAND
LONG - PERIOD
SEISMIC SYSTEM

B